Final Report--Objective D, Task 1, and Objective G, Task 1

December 1987

COMPUTER-ASSISTED SEARCH (U)

By: JESSICA M. UTTS
EDWIN C. MAY
NEVIN D. LANTZ
BEVERLY S. HUMPHREY

Prepared for:

PETER J. McNELIS, DSW
CONTRACTING OFFICER'S TECHNICAL REPRESENTATIVE

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Objective G, Task 1
Covering the Period 1 October 1985 to 30 September 1987

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ABSTRACT (U)

(U) One reported psychoenergetic skill, known to the general public as "dowsing," is the ability to locate lost or hidden items of interest. In an effort to bring this putative ability that we call "search" into the laboratory, a computer-assisted search (CAS) experiment was conducted in FY 1984 and again in FY 1986. Participants scanned a computer graphics display and attempted to locate a hidden computer-generated target. In each experiment, two conditions were randomly interchanged in a balanced protocol: (1) the target was fixed in space (space condition), and (2) the location of the target was randomly shifted several times each second (time condition). Both the subjects and the experimenter were blind to the condition on each trial.

(S/NF) In FY 1984, five of seven participants demonstrated an above chance ability to find targets in one of the two conditions: three in the time condition and two in the space condition. Of the 36 participants in the FY 1986 experiment, two showed above chance results in the space condition and six in the time condition. No participant in either experiment was able to produce results in both conditions independently.

(S/NF) A follow-up experiment was done in FY 1986 to see if subjects would produce better results if they were only presented with the single condition for which they had done well in the original experiment. None of the eight subjects who completed this "single condition" experiment scored significantly.

(S/NF) In FY 1987, an experiment was conducted which successfully replicated the original FY 1986 finding. Of eight participants (six experienced and two novices), the two who scored best in the space condition had previously been successful in that condition, and the one who scored best in the time condition had previously been successful in that condition. This suggests that participants are likely to consistently do well in one condition or the other, but not both. Only one of the eight participants scored significantly in the space condition, and none

(S/NF)
in the time condition, but the level of significance for the one subject rendered the entire experiment significant.

(S/NF) This is the third laboratory replication of this experiment. In each experiment, there were significant results which could have been useful in military applications. The best subject in the FY 1987 experiment showed a reduction in the area that would need to be searched in 72% of the trials in the space condition, with an average reduction in area of 33%. Previous experiments showed even greater reductions. In real-world applications, this could represent a substantial savings in resources. However, the skill has not been shown to be completely robust, and more experimentation should be done before attempting these applications.

(U) A second "search" experiment was conducted in FY 1987 to see if self-proclaimed dowsers could "find" a lost ship by searching a grid which had previously been keyed to a map. The object of the search was a sunken Spanish galleon called the *Atocha*, which was actually found in 1985. The experiment was carried out with two sets of 25 trials for each of five participants, but failed to produce a single significant result.

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I INTRODUCTION (U)

A. (U) Overview

(S/NF) A continuing requirement of the intelligence community is to determine the location of military targets whose positions are either not known, or are known only approximately. Examples of such targets are a hidden microphone in a secure facility, a command post in a tactical situation, a submarine in a strategic situation, or a kidnap victim who is being held hostage.

(S/NF) It has been claimed by the parapsychological community that certain people can search for and locate water, oil, minerals, objects, individuals, sites of archaeological significance, and so forth. This purported ability is most often referred to as "dowsing" in the Western literature, and "biophysical effect (BPE)" in the Soviet/East Bloc literature.* In this report,† we shall refer to such techniques simply as "search." If "search" can be demonstrated to be a genuine ability, and if it can be applied to targets of military interest, then we may have a potential contribution to meeting the intelligence community's requirement.

(U) This ability can be contrasted to the related remote viewing ability in the following manner. In remote viewing, the viewer is given location information (e.g., coordinates, a beacon agent, or a picture), then asked to provide data on target content. In "search," the viewer is given information on target content, then asked to provide location data (e.g., position on a map). The two functions thus complement each other.

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*(U) For a comprehensive survey of the claims for dowsing, see Christopher Bird, *The Divining Hand,* E. P. Dutton, New York, New York (1979).

†(U) This report constitutes the deliverable for Objective D, Task 1 and Objective G, Task 1.

(U) To see whether or not this purported "search" ability could be brought under laboratory control, a computer-assisted search (CAS) routine was developed. This routine consists of the following elements:

(1) A finite matrix of possible target locations (e.g., a 20 x 20 graphics matrix grid) from which one cell is randomly selected by the computer as the target.

(2) An individual whose task is to "scan" the graphics display area with a computer mouse, and indicate, by pressing the button on the mouse, his/her choice as to the target location.

(3) A feedback mechanism that displays the response and actual target location.

(4) An *a priori* defined analysis procedure to compare the targets with the responses.

B. (U) Background

(U) Using this general procedure, an experiment was conducted during FY 1984 in which two conditions were tested simultaneously:[1]*

- The target remains fixed in space for the duration of the trial (space condition).
- The target is rapidly moving to various locations, so that the subject must push the button at exactly the right time (time condition).

(S/NF) Seven subjects, who were blind to the space/time condition, were each asked to contribute 50 trials (25 space, 25 time). Five of them produced independently significant results: three in time only and two in space only. No participant was successful at both space and time conditions.

(U) A larger pool of subjects was used to try to replicate this finding in FY 1986. Participants were chosen on the basis of interest and availability, and included both experienced and novice subjects. As in the FY 1984 experiment, each subject contributed 25 trials under each of the two conditions, space and time, and were blind to the condition in force for each trial. Most subjects were unaware that there were two conditions.

(S/NF) Thirty-six subjects participated in the FY 1986 experiment. Results were analyzed by separating the trials collected under the two conditions, as before. Six subjects attained significant results ($p < 0.05$) in the time condition, and two in the space condition. The smallest

* (U) References are listed at the end of this report.

(S/NF)
attained p-value was 0.0001. The probability of obtaining such an extreme result, with 72 separate tests (36 in each condition), is 0.007. {The appropriate formula for this is $[1 - (1 - 0.0001)^{72}]$, where in general the smallest p-value in an experiment with n separate tests is used instead of 0.0001, and n is used in place of 72.}[2]

(S/NF) In both years of testing, no participant scored significant hits in both the time and space conditions. (There were two subjects in FY 1986 who scored significantly in the direction of missing the target under both conditions.) This observation led to the question of whether or not talented subjects bifurcated into two groups: those who could search over a spatial area, and those who could push the button at just the right time. A follow-up experiment was proposed in FY 1986 to test this.

(S/NF) Eleven subjects who had done well in the original FY 1986 experiment were asked to participate in a "single condition" experiment in which they would search under only the condition for which they had scored well. Thus, those who scored better in time were told of this fact, and were told that the target was constantly moving. Similarly, those who had done well with a fixed target were tested only under this condition, and were explicitly told that the target was stationary. Eight subjects completed this experiment. Results from this single condition experiment proved to be nonsignificant for all subjects.

C. (U) Experiments for FY 1987

(U) Since the FY 1984 and the original FY 1986 experiments had shown evidence of "search" ability, and since the only change in the follow-up FY 1986 experiment had been to remove the random assignment of the space and time condition, it was decided that an experiment should be conducted in FY 1987 in which the random space and time conditions were again used. This will be further discussed in this report, under the title of "Computer-Assisted Search Experiment."

(U) As another test of "search" ability, an experiment was conducted during FY 1987 with a group of five self-proclaimed dowsers. The purpose of this experiment was to see if any of these individuals could come closer than expected by chance to locating a shipwreck, by

(U)

identifying a spot on a map. This experiment will be further discussed in this report as "The *Atocha* Experiment."

II METHOD OF APPROACH (U)

A. (U) The Computer-Assisted Search Experiment

(U) The FY 1987 Computer-Assisted Search Experiment was designed as a further test of the hypothesis that some individuals have an ability to search a bounded area on a computer screen and identify the location of a hidden "target." Eight subjects participated in the experiment, six of whom had participated in the unsuccessful FY 1986 "single condition" experiment, and two who were novices to this task. Each subject contributed 25 trials in the space condition and 25 trials in the time condition.

(U) To test a participant on the space condition, the target location was fixed throughout the trial. To test the time condition, the target location was changed several times each second. The computer selected one of the conditions for each trial by a balanced random protocol, so that each set of ten trials contained five of each type. The participant and experimenter were blind as to which condition was being presented on any given trial.

(U) A Sun Microsystems work station computer was used to conduct all aspects of this experiment. This computer system is noted for its high-resolution graphics display and graphics input device. The particular random number generator algorithm used in this experiment has been studied in detail and is found to be adequate for multidimensional applications.[3]

(U) The approach used was a modification of a procedure originally developed by Dr. Dean I. Radin at Bell Laboratories for evaluating geometric-distance scores in a perceptual task.[4] The target area of interest is constructed as a square. A grid system is then laid down over the square in the form of an n x n matrix, to yield n^2 separate grid cells (e.g., 400 for a 20 x 20 grid). The computer randomly selects one of the grid cells as the target for a particular trial in the space condition, and rapidly changes the potential target in the time condition. The subject's task is to locate the target, by moving a mouse-driven cursor around the target area and pushing a button when the moment seems right. In the time condition, the potential target in force when the computer registers the subject's button press becomes the actual target. Since the potential target is moving fast enough so that it is likely to be in any given cell every few seconds, the subject would not have to move the cursor at all in order to capture the target. In both conditions, the response is defined as the grid cell where the cursor is located when the button is pressed.

(U) In our experiment, a bounded area representing the perimeter of a 20 x 20 cell matrix was shown to the participant, with the additional option of having the 400 individual squares of the grid displayed. Figure 1 shows the display with the grid option. The participant was told that the target could be anywhere within the square, and that he/she should move the cursor around, and push the button on the mouse when the moment "seemed right." The computer was programmed to give immediate feedback to the participant following each trial by automatically displaying the target cell as a filled square and the participant's choice as a shaded square, with a line connecting the two (see Figure 1). After several seconds of the feedback display, the computer recycled to the next trial. Coordinates of the target and response were stored for future analysis.

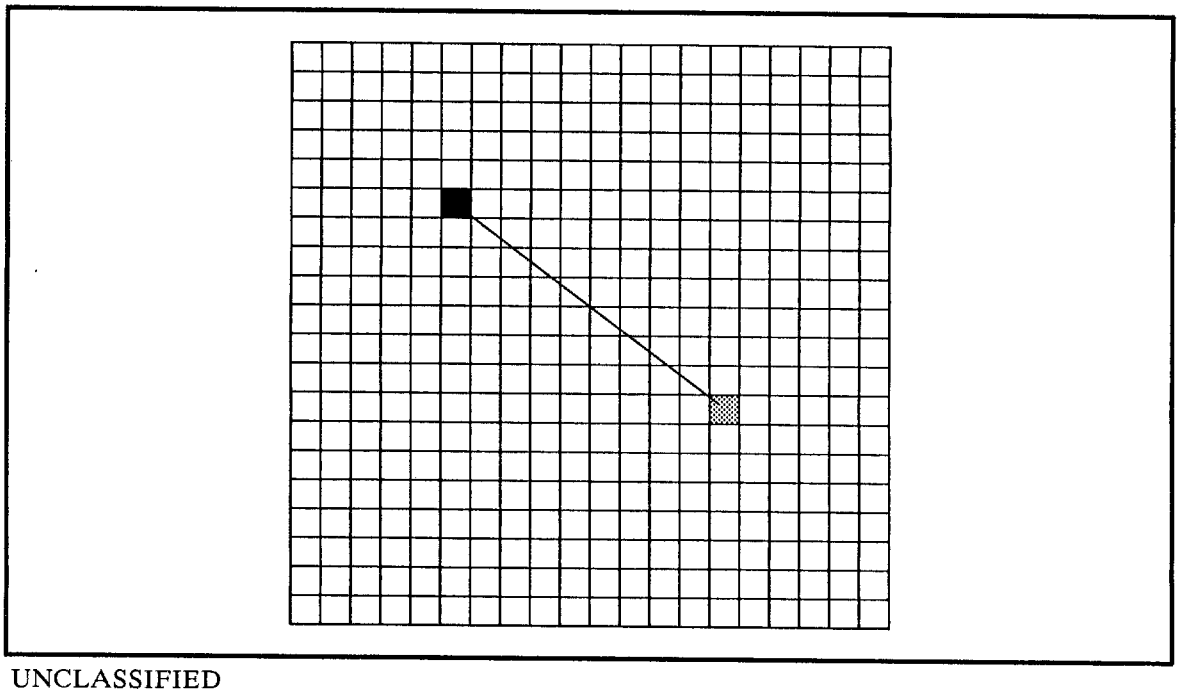

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FIGURE 1 (U) SEARCH MATRIX COMPUTER DISPLAY WITH FEEDBACK

B. (U) The Atocha Experiment

(S/NF) To take the search task out of the laboratory, five self-proclaimed dowsers were asked to participate in an experiment to see if any of them could find an object by searching a map. (One of them, Viewer 198, has been part of the SRI Psychoenergetics Project since 1984. At times he/she has performed excellently in operational tasks and in real-world laboratory search tasks. However, his/her overall performance

(S/NF)
has been mixed.) The object used for the experiment was the wreck of a Spanish galleon, *Nuestra Senora de Atocha,* which sank during a hurricane in 1622. The wreckage was found off the coast of Key West, Florida, on 20 July, 1985. It was selected as the target for this experiment because, although its location was already known, the considerable wealth it contained and its fascinating historical background made it something that would have been worth searching for. The purpose of this task was to simulate a situation in which the searchers would be excited about finding the target because of its value. Of course the experiment was designed in such a way that knowing the actual location of the wreckage would not help the searchers succeed in the experiment.

1. (U) Preliminary Activities

(U) To create a high level of interest in the experiment, SRI personnel visited Florida and conducted two preliminary activities. First, they accompanied Viewer 198 to the *Atocha* museum and discussed the experiment and the *Atocha* history in detail with him/her. Later, before beginning the experimental trials, Viewer 198 showed a *National Geographic* videotape of the search for the *Atocha* to the other four participants.

(U) The second preliminary activity was to conduct a few real-world search trials with Viewer 198, for a less important, but known, Spanish galleon wreck, the *San Pedro.* For these trials the location of the *San Pedro* wreck was marked on a map. Three white paper disks, scaled to correspond to 5,000 yards in diameter (6.34 square miles), were randomly keyed to the map and marked with a secret orientation code so that the experimenter could later rematch them to the map. The actual map location of the *San Pedro* was constrained to be somewhere on each of the three disks.

(U) To add to the excitement of the task, the data were collected while Viewer 198 and the SRI personnel were in a vessel anchored directly above the wreck. Viewer 198 was given the three disks and asked to mark on each of them the spot where he/she felt the wreck and thus his/her current location were. We had hoped that "searching" for yourself as a beacon would contribute to the success of the trial.

(U) Each disk was rematched to the map and the center of gravity (CG) for the three responses was calculated. Viewer 198's CG corresponded to a spot 500 yards from the wreck. If

(U)
a "real search" had been initiated at Viewer 198's spot, a 96% reduction in search area would have been realized over starting at a random location.

(U) Encouraged by this demonstration trial, we proceeded with the search for the *Atocha*.

2. (U) Experimental Details

(U) The five participants in the *Atocha* experiment conducted their searches in group meetings at one participant's home. During each weekly meeting, each subject attempted five guesses. These were recorded by filling in a square on a piece of paper containing a 20 x 20 grid similar to that shown in Figure 1. These responses were then mailed to SRI International for evaluation. Previous to the time of the meeting, an experimenter at SRI had generated a target square for each participant, for each of the trials. This was done using a computer randomization scheme to select one of the 400 squares in the grid. To simulate real conditions as much as possible, the grid was placed on a map of the Key West area with the target square centered on the spot where the *Atocha* had been found. Thus, each week there were five such grids, ordered numerically by trial number, for each participant. If the participant filled in the correct square on a given response grid, then when the grid used for that trial was placed on the map, the response would be directly over the spot where the *Atocha* was found.

(U) The experiment was initially scheduled to run for five weeks, with each participant contributing a total of 25 trials. However, at the end of that period the participants submitted and were granted a request to repeat the experiment, so the entire experiment consists of two sets of 25 trials for each subject.

C. (U) Analysis

(U) In both the CAS and the *Atocha* experiments, the basic unit of data for analysis consisted of sets of 25 target/response pairs. Within each pair, the data recorded were the coordinates of the target and the response from their locations on the 20 x 20 grid. In the CAS experiment, each of the eight subjects contributed one such set in the time condition and one in the space condition. For the *Atocha* experiment, each of the five subjects contributed two sets, one during each of the two five-week periods in the experiment.

(S/NF) In the context of a military application, the question of interest is whether or not the information provided by the participant

(S/NF)
would help reduce the time needed to find the target. This is equivalent to reducing the area over which it is necessary to search before the target is located.

(U) Assume that in the absence of any information, a search would proceed by randomly selecting a square on the grid and searching that square. If the target is not found, then the squares closest to the original one are searched, in random order. This continues, by progressively moving away from the original square, until the target is found. At each stage, the set of squares equidistant from the original one, which have not yet been searched, are selected in random order and searched.

(U) To analyze the success of these experiments, the average time required to find the target using this procedure with the subject's guess as the starting point should be compared to the average time required using a random starting point.

(U) The number of squares that must be searched could range anywhere from one (if the target is in the original starting square), to the total number of squares, which is 400 for our experiments. In the absence of any information, and assuming that the target is equally likely to be anywhere in the grid, the probability that exactly s squares must be searched is 1/400, for any integer value of s from one to 400. In other words, s follows what is called a "discrete uniform distribution." It is as likely that all 400 squares will have to be searched as it is that the target will be found in the first square. This result is independent of the starting square.

(U) The item of interest from each trial is the number of squares that would have to be searched to find the target. To compute this, we first find the straight line distance from the response to the target using the formula:

$$d = \sqrt{(Y_1 - Y_2)^2 + (X_1 - X_2)^2},$$

where (X_1 , Y_1) and (X_2 , Y_2) are the coordinates of the target and the response, respectively.

(U) Next, we count the number of squares that are closer to the response than is the actual target, since all of those would have to be searched before the target would be found. Finally, we add to the count half of the number of squares that are exactly d units from the response, since on the average half of the squares at that distance would have to be searched

(U)

before finding the one with the target. In symbols, if we define p as the proportion of squares that must be searched to find the target, then:

$$p = \frac{\sum_{r=0}^{r<d} n(D_r) + 0.5\, n(D_d)}{400},$$

where n(Dr) represents the number of squares exactly r units from the response. One advantage of working with these proportions is that we can estimate a meaningful quantity, the expected reduction in area searched, instead of simply testing for significance.

(U) To determine whether or not a given set of 25 trials produced a result significantly different from chance, we compare the average proportion of the grid searched to what would be expected by chance. We can compute a z-score by subtracting the expected average, which is 0.5 x (201 - 400) = 0.50125, from the average p, then dividing by the standard deviation, which is $\sqrt{1/12n}$. Thus,

$$z = \sqrt{12n}\,(0.50125 - \bar{p}).$$

In this case, n = 25.0 Using the Central Limit Theorem, a set of 25 trials will be declared to be significant if $z \leq -1.645$.

(U) The p-value for an entire experiment will be based on the minimum p-value across all subjects. If there are N subjects, the appropriate formula for this will be overall p-value = [1 - (1 - min p-value)^N].[2]

(U) This formula is based on the minimum of N independent samples from a standard uniform distribution. Under the null hypothesis, p-values should follow such a distribution. This procedure was introduced by Tippett in 1931, and was the first test of significance based on combined results.[2] It is most powerful when one or more subjects can produce a large effect, even if others cannot. This seems to be a good model for what appears to be happening in psi research, so this procedure would be appropriate.

III RESULTS (U)

A. (U) The Computer-Assisted Search Experiment

(S/NF) Table 1 shows the average proportion of squares that would have to be searched to find the target, and the corresponding p-values for each participant in each condition. One individual achieved a significant p-value in the space condition, and none did in the time condition. The subject who achieved significant results (Subject 837) had done so in the space condition in the FY 1986 experiment also (with p = 0.04), but did not participate in the FY 1984 experiment. Subject 164, who showed a p-value of 0.066 in the space condition in this experiment, had a significant result (p = 0.031) in the space condition in FY 1984, and significantly missed the target (p = 0.98) in the FY 1986 space condition. Neither of these subjects scored anything other than chance in the time condition in any of the experiments. The third-ranked subject (Subject 150, p = 0.109) was a novice.

Table 1

(U) RESULTS FOR COMPUTER -ASSISTED SEARCH EXPERIMENT

	SPACE CONDITION		TIME CONDITION	
Subject I.D.	Average proportion of squares searched	p-value	Average proportion of squares searched	p-value
837 *	0.3353	0.002	0.5008	0.497
164 *	0.4143	0.066	0.4396	0.143
150 ‡	0.4302	0.109	0.4715	0.303
463 †	0.4771	0.338	0.5837	0.923
235 ‡	0.4801	0.357	0.5224	0.643
300 †	0.5023	0.507	0.4337	0.121
428 †	0.5454	0.778	0.5740	0.896
432 *	0.5649	0.865	0.5089	0.552

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* Previously significant in space. † Previously significant in time. ‡ Novice

(S/NF) Based on the minimum p-value of 0.002, the overall level of significance for the experiment with the space condition is 0.016. For

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the time condition, it is 0.644 (minimum p = 0.121). For the entire experiment, the minimum p-value is still 0.002, but it is based on 16 replications, so the overall significance level is 0.032.

(S/NF) A more interesting result with regard to potential applications is an estimate of the reduction in the area that would have to be searched if the responses given by these subjects were used instead of randomly choosing a starting point. This can be computed by comparing the average proportions given in Table 1 with the chance average of 0.50125.

(S/NF) For Subject 837, under the space condition, the average reduction would be 33%. For example, if a search was undertaken for a kidnap victim, and this subject achieved the personal average level of functioning demonstrated in this experiment, 33% less area would have to be searched before the victim was found than if a random starting point was used. Even though only one subject had a significant result, combining all subjects' guesses in the space condition would still give an average reduction of 6.5% in the area searched. Depending upon the application, this reduction could still represent a substantial savings in expenditure of resources. In the time condition however, the results indicate that there would be no change in search time over chance.

(S/NF) In addition to looking at the average reduction in search area, it is of interest for applications to know what percent of the trials would have resulted in a smaller search area than expected by chance. For Subject 837 in the space condition, 18 out of 25, or 72% of all trials resulted in a savings. This means that if this subject were used repeatedly to suggest a starting point for searches, approximately 72% of all targets would be found in less time than average, and 28% would require more than the average. In contrast, a random starting place should result in about 50% above and 50% below average search times. For all subjects combined in the space condition, 104 out of 200, or 52% of all trials resulted in a savings in search area. For the time condition only, 102, or 51% resulted in a smaller search area than would be expected by chance.

B. (U) The Atocha Experiment

(U) Results for the search for the *Atocha* are given in Table 2. None of the subjects attained a significant result in either experiment. The overall significance level for the experiment, based on the minimum p-value (0.368), is 0.99. This indicates that the results were extremely close to chance. In fact, results this close to chance or closer, using the minimum p-value as a measure, would be expected to occur only 1% of the time. For the two experiments taken individually, the minimum p-values were 0.371 and 0.368, each of which gives an overall experiment significance level of 0.90.

(U) On the average, there would have been an increase of 4% in search time using the information provided by this group of subjects.

Table 2

(U) RESULTS FOR THE ATOCHA EXPERIMENT

	EXPERIMENT 1		EXPERIMENT 2	
Subject I.D.	Average proportion of squares searched	p-value	Average proportion of squares searched	p-value
D1	0.4810	0.371	0.4806	0.368
D2	0.4900	0.431	0.4836	0.388
D3	0.6033	0.963	0.5442	0.778
D4	0.5632	0.863	0.5411	0.762
D5	0.5033	0.523	0.5188	0.628

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IV DISCUSSION AND CONCLUSIONS (U)

(S/NF) The experiments discussed in this report were designed to replicate and extend earlier findings which indicated that selected participants could use psychic means to help search for a hidden target. The computer-assisted search experiment, which served as a direct replication of the experiments conducted in FY 1984 and FY 1986, once again showed promising results. As in the earlier experiments, no subject was able to produce significant results independently in both the time and the space conditions. Further, the two subjects who produced the best results did so in the space condition, which replicated their performance in the earlier experiments. The best subject in the time condition had scored significantly in the time condition in FY 1986, but not in space. In general, those who did well in this experiment (excluding one novice) did so in the same condition for which they had previously scored significantly.

(S/NF) Even though n is small, we were able to speculate that subjects bifurcate into those who can search for fixed targets (space) and those who can identify when to register a guess (time). It would appear that each subject would do best in an experiment which contained only the preferred condition. A study done this year to test that notion produced completely chance results. Thus, it appears that even if this bifurcation does exist, it is best to present subjects with randomly scrambled conditions. Perhaps the knowledge of exactly what the task requires adds an analytical component which is hard to overcome. This has been observed in other psychic functioning, such as forced choice guessing of targets in remote viewing.

(S/NF) This is the third year in which a computer-assisted search experiment has provided evidence that psychic functioning may be of some use in meeting the military requirement of searching for hidden or lost targets. Although such functioning is not completely predictable, it appears to be robust enough, when selected subjects are used, to

(S/NF)
significantly reduce the average search time from what it would be if randomly located starting points were used.

(U) The *Atocha* experiment, which was designed to see if self-proclaimed "dowsers" would be able to locate a lost object using a grid overlaid on a map, did not produce a significant finding, although a preliminary experiment showed very promising results. It is difficult to base conclusions on one experiment with a small sample size. However, it appears that whatever produced the functioning with selected subjects in the computer-assisted search in the laboratory did not carry over to the conditions of the *Atocha* experiment.

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